

CLAIMS

1. A continuously variable transmission (1) for motor vehicles, provided with a primary pulley (2) and a secondary pulley (3), around which there is arranged a drive belt (10) which, at least when the transmission (1) is operating, is clamped, via substantially axially oriented running surfaces (16) arranged on either side of the drive belt (10), between two conical pulley disks (21, 22) of the primary pulley (2) with a primary clamping force ( $K_p$ ) and between two conical pulley disks (31, 32) of the secondary pulley (3) with a secondary clamping force ( $K_s$ ) in order to be able to transmit a supplied torque ( $T_p$ ) with the aid of frictional forces from the primary pulley (2) to the secondary pulley (3), a contact surface (40) of at least one pulley disk (44) with respect to the drive belt (10) being provided, at least as seen in a cross section thereof that is oriented perpendicular to a tangential direction, with a curvature, with the result that in said cross section a contact angle ( $\lambda$ ) between a tangent line (41) on the contact surface (40) and a radial direction (42) varies in relation to a radial position ( $R_p$ ,  $R_s$ ) of a contact point between the respective running surface (16) of the drive belt (10) and the contact surface (40) varies between a lowest value at the location of a radially innermost position on the contact surface (40) and a highest value at the location of a radially outermost position on the contact surface (40), and a transmission ratio ( $R_s/R_p$ ) of the transmission (1) being defined as the quotient between the radial position ( $R_s$ ) for the secondary pulley (3) and the radial position ( $R_p$ ) for the primary pulley (2), characterized in that as a result of the contact angle ( $\lambda$ ) being adapted in relation to said radial position ( $R_p$ ,  $R_s$ ) and at least in the largest transmission ratio ( $R_s/R_p$ ), i.e. low, a clamping force ratio ( $K_p K_s$ ) between the primary clamping force ( $K_p$ ) and the secondary clamping force ( $K_s$ ) has a value in the range between 1 and the clamping force ratio ( $K_p K_s$ ) in the smallest transmission ratio ( $R_s/R_p$ ), i.e. Overdrive.

2. The continuously variable transmission (1) as claimed in claim 1, characterized in that as a result of the contact angle ( $\lambda$ ) being adapted in relation to said radial position ( $R_p$ ,  $R_s$ ) and in Overdrive, the clamping force ratio ( $K_p K_s$ ) has a value in the range between 1.8 and the clamping force ratio ( $K_p K_s$ ) in Low.

3. The continuously variable transmission (1) as claimed in claim 1 or 2, characterized in that as result of the contact angle ( $\lambda$ ) being adapted in relation to said radial position ( $R_p$ ,  $R_s$ ), and in all transmission ratios ( $R_s/R_p$ ) of the transmission (1), the clamping force ratio ( $K_p K_s$ ) has a value in the range between 1.2 and 1.6, and preferably in the range between 1.3 in Low and 1.5 in Overdrive.

4. The continuously variable transmission (1) as claimed in claim 1, 2 or 3, characterized in that a safety factor ( $S_f$ ) between a minimum primary or secondary clamping force ( $K_p$ ;  $K_s$ ) required for the transmission of the torque ( $T_p$ ) supplied in the respective transmission ratio ( $R_s/R_p$ ) mentioned and a desired primary or secondary clamping force ( $K_{pDv}$ ;  $K_{sDv}$ ) is approximately 1.3.

5. The continuously variable transmission (1) as claimed in one of the preceding claims, characterized in that, at least for a constant transmission ratio ( $R_s/R_p$ ), a desired secondary clamping force ( $K_{sDv}$ ) is determined by multiplying a minimum secondary clamping force ( $K_s$ ) required for the transmission of the supplied torque ( $T_p$ ) by a safety factor of greater than 1, and in that a desired primary clamping force ( $K_{pDv}$ ) is determined by multiplying said desired secondary clamping force ( $K_{sDv}$ ) by the clamping force ratio ( $K_p K_s$ ) in said constant transmission ratio ( $R_s/R_p$ ).

6. The continuously variable transmission (1) as claimed in one of the preceding claims, characterized in that the contact angle ( $\lambda$ ) in relation to said radial position ( $R_p$ ,  $R_s$ ) is at least substantially equal for the two pulley disks (21, 22; 31, 32) of a respective pulley (2, 3).

7. The continuously variable transmission (1) as claimed in one of the preceding claims, characterized in that a lowest value of the contact angle ( $\lambda$ ) for the pulley disks (21, 22, 31, 32) in relation to said radial position ( $R_p$ ,  $R_s$ ) is at least substantially equal for the pulley disks (21, 22, 31, 32) of the two pulleys (2; 3).

8. The continuously variable transmission (1) as claimed in one of the preceding claims, characterized in that a highest value for the contact angle ( $\lambda$ ) for the pulley disks in relation to said radial position ( $R_p$ ,  $R_s$ ) is higher for the pulley disks (21, 22) of the primary pulley (2) than the corresponding value for the pulley disks (31, 32) of the secondary pulley (3).

9. The continuously variable transmission (1) as claimed in one of the preceding claims, characterized in that the drive belt (10) is of what is known as the push belt type and is provided with at least one set of rings (12) and a large number of transverse elements (11), which can move along the set of rings (12) in the circumferential direction thereof and are provided with the running surfaces (16).

10. The continuously variable transmission (1) as claimed in one of the preceding claims, characterized in that the contact angle ( $\lambda$ ) in relation to said radial position ( $R_p$ ,  $R_s$ ) corresponds for the two pulley disks (21, 22; 31, 32) of a respective pulley (2, 3), and in that, at least in the smallest transmission ratio ( $R_s/R_p$ ) of the transmission (1), a ratio between the contact angle ( $\lambda$ ) for the primary pulley ( $\lambda_p$ ) and the contact angle ( $\lambda$ ) for the secondary pulley ( $\lambda_s$ ) satisfies the condition that:

$$1 < \frac{\tan(\lambda_p)}{\tan(\lambda_s)} \leq 1.6$$

11. The continuously variable transmission (1) as claimed in the preceding claim, characterized in that, at least in the largest transmission ratio ( $R_s/R_p$ ) of the transmission (1),

the ratio between said contact angles ( $\lambda_p$ ,  $\lambda_s$ ) satisfies the condition that:

$$0.6 < \frac{\tan(\lambda_p)}{\tan(\lambda_s)} \leq 1$$

5 12. The continuously variable transmission (1) as claimed in claim 10 or 11, characterized in that for both the primary pulley (2) and the secondary pulley (3) the lowest value for the contact angle ( $\lambda$ ) is approximately 7 degrees.

10 13. The continuously variable transmission (1) as claimed in claim 10, 11 or 12, characterized in that for the primary pulley (2) the highest value for the contact angle ( $\lambda$ ) is approximately 10 degrees, and in that for the secondary pulley (3) the highest value for the contact angle ( $\lambda$ ) is  
15 approximately 9 degrees.

14. A continuously variable transmission (1) for motor vehicles, provided with a primary pulley (2) and a secondary pulley (3), around which there is arranged a drive belt (10)  
20 which, at least when the transmission (1) is operating, is clamped, via substantially axially oriented running surfaces (16) arranged on either side of the drive belt (10), between two conical pulley disks (21, 22) of the primary pulley (2) with a primary clamping force ( $K_p$ ) and between two conical  
25 pulley disks (31, 32) of the secondary pulley (3) with a secondary clamping force ( $K_s$ ) in order to be able to transmit a supplied torque ( $T_p$ ) with the aid of frictional forces from the primary pulley (2) to the secondary pulley (3) characterized in that, at least when the transmission (1) is  
30 operating, a coefficient of friction between the primary pulley (2) and the drive belt (10) in relation to a radial position ( $R_p$ ) of a contact point between them has a lowest value at the location of a radially outermost position of said contact point.

35 15. The continuously variable transmission (1) as claimed in claim 14, characterized in that said coefficient of friction is lower than a coefficient of friction between the secondary

pulley (2) and the drive belt (10) at the location of a radially outermost position of a contact point between them.

16. The continuously variable transmission (1) as claimed in  
5 claim 14, characterized in that, at least as seen in a tangential cross section, the primary pulley disks (21, 22), at the location of said radially outermost position of the contact point between the primary pulley (2) and the drive belt (10), are provided with a relatively large radius of  
10 curvature (R40) and/or a relatively low surface roughness.

17. The continuously variable transmission (1) as claimed in one of the preceding claims, characterized in that the contact angle ( $\lambda$ ) for the two pulley disks (21, 22; 31, 32)  
15 of a respective pulley (2, 3) has a value which corresponds, and in that for both the primary pulley ( $\lambda_p$ ) and the secondary pulley ( $\lambda_s$ ) the respective contact angle ( $\lambda$ ) in relation to the transmission ratio ( $R_s/R_p$ ) of the transmission (1) at least substantially corresponds to the  
20 contour shown for this parameter in the associated figure 12.

18. The continuously variable transmission (1) as claimed in one of the preceding claims, characterized in that the clamping force ratio ( $K_p/K_s$ ) in relation to the transmission  
25 ratio ( $R_s/R_p$ ) of the transmission (1) has an at least approximately constant value.

19. A motor vehicle having an engine and a load that is to be driven, between which a transmission (1) according to one  
30 of the preceding claims is incorporated, a power which is to be generated by the engine being transmitted by the drive belt (10) from the primary pulley (2) to the secondary pulley (3) and being output to the load by the secondary pulley (3).